

FLUKE.

**8508A Reference Multimeter
Extended Specifications**



+10.000 0000 3v

Interpreting and applying the specifications

Introduction

The Fluke 8508A has been designed specifically for metrologists. Not only does it provide the performance metrologists need, but it is specified in a way to allow users to really understand the uncertainties of the measurements, and easily make allowance for those uncertainty contributions when performing measurement uncertainty analyses and compiling uncertainty budgets. Contemporary metrology practices, including ISO 17025 based laboratory accreditation schemes, require uncertainty analysis to be performed in accordance with the statistically based techniques described in the ISO Guide to the Expression of Uncertainty in Measurement (often referred to as the 'GUM'). For convenience, the 8508A specifications are quoted at a coverage factor of $k=2$, equivalent to a confidence level of approximately 95 %, as required by these methods. Specifications are also provided at a confidence level of 99 %.

Performance specifications for the 8508A consist of two elements; the first is a contribution expressed as parts-per-million of the Reading, and the second contribution is expressed as parts-per-million of the Range. These must be evaluated and combined for the relevant reading and range values applicable to the measurement being made, ensuring that both elements are evaluated on the same basis, such as parts per million of the measured value or in absolute terms (volts, amps, ohms, etc). The two elements are combined by adding algebraically. For example, measuring 10 V on the 20 VDC range and applying the 365 day ± 1 °C specifications:

$$\pm\left(3.0 + 0.2 \times \frac{20}{10}\right) \\ = \pm(3.0 + 0.4) = \pm 3.4 \text{ ppm of } 10 \text{ V}$$

First, expressing the contributions in terms of parts-per-million of the measured value.

Second, expressing the contributions in volts:

$$\pm(3.0 \times 10^{-6} \times 10 + 0.2 \times 10^{-6} \times 20) \\ = \pm 3.4 \times 10^{-5} = \pm 34 \mu\text{V}$$

The 8508A is designed to provide accuracy and stability without the need for internal auto or self calibration routines which may otherwise compromise the continuity and traceability of measurement performance history.

To realize the full potential of the 8508A performance, accepted metrology practices should be employed, such as performing a zeroing or null operation to remove any offsets present in the measurement setup when making DC measurements. The 8508A specifications assume that these methods are employed.

Absolute and Relative specifications

The Relative to Calibration Standards specifications describe the performance of the 8508A itself for the time periods and temperature range listed, excluding the uncertainty of the standards used to perform calibration of the 8508A during manufacture. The Absolute specifications include the uncertainty of the standards used to perform calibration of the 8508A at manufacture and may be used to determine the uncertainty of measurements made with the 8508A for periods up to 1 year and over a temperature range of ± 5 °C from calibration. If the user has their 8508A calibrated with different uncertainties, the Relative specifications can be combined with the uncertainties applicable to that calibration to determine the effective absolute uncertainty following that calibration.

Applying user's calibration uncertainties

When the 8508A is calibrated by another laboratory, the uncertainties of the calibration standards used may be applied by combining those uncertainties with the 8508A's Relative to Standards specifications. The applicable calibration uncertainties and the 8508A relative specifications must both be expressed at the same confidence level, and be combined in an RSS (Root Sum Square) summation. Accepted metrology practice mandates that calibration uncertainties are stated at 95 %. Check the applicable calibration uncertainties are stated at 95 % and then combine them with the 8508A 95 % Relative specifications. For example, if the 8508A is calibrated at 10 VDC with an uncertainty of 1.5 ppm at 95 % the absolute uncertainty at 10 V for a period of 90 days and ± 1 °C from calibration is:

$$\pm\sqrt{1.5^2 + \left(1.4 + 0.2 \times \frac{20}{10}\right)^2} \\ = \pm 2.3 \text{ ppm of } 10 \text{ V}$$

Applying the specifications

Operating and calibration temperature ranges

As a metrology tool, the 8508A will commonly be used in a calibration laboratory where the temperature would be controlled to $\pm 1\text{ }^{\circ}\text{C}$, and the 8508A $\pm 1\text{ }^{\circ}\text{C}$ specifications are applicable to those situations. The majority of electrical calibration laboratories operate at a nominal temperature of $23\text{ }^{\circ}\text{C}$, the temperature at which the 8508A is calibrated by Fluke during manufacture and service. The 8508A is also capable of being calibrated at any temperature between $20\text{ }^{\circ}\text{C}$ and $25\text{ }^{\circ}\text{C}$ and the $\pm 1\text{ }^{\circ}\text{C}$ specifications will apply to operation within $\pm 1\text{ }^{\circ}\text{C}$ of that calibration temperature. In the 8508A specification tables, the temperature of calibration is referred to as TCal. Specifications for $\pm 5\text{ }^{\circ}\text{C}$ are provided for situations where the 8508A is operated in environments with wider temperature variations up to $\pm 5\text{ }^{\circ}\text{C}$. For applications where the knowledge of the effect of temperature on 8508A performance is important, temperature coefficients are listed in the 8508A specifications. If the operating temperature is within the range $15\text{ }^{\circ}\text{C}$ to $30\text{ }^{\circ}\text{C}$, the $15\text{ }^{\circ}\text{C}$ to $30\text{ }^{\circ}\text{C}$ temperature coefficient specifications are applicable; otherwise use the $5\text{ }^{\circ}\text{C}$ to $15\text{ }^{\circ}\text{C}/30\text{ }^{\circ}\text{C}$ to $40\text{ }^{\circ}\text{C}$ figures, provided the temperature lies within that range. The 8508A may be operated at temperatures between $0\text{ }^{\circ}\text{C}$ and $50\text{ }^{\circ}\text{C}$, but performance is not specified outside the range $5\text{ }^{\circ}\text{C}$ to $40\text{ }^{\circ}\text{C}$.

Applying temperature coefficient specifications

The 8508A specification tables include information for the typical operating conditions of $\pm 1\text{ }^{\circ}\text{C}$ for calibration laboratories with tight temperature control, and $\pm 5\text{ }^{\circ}\text{C}$ for calibration laboratories with looser temperature control or uncontrolled environments within that temperature range. For the majority of applications, choosing the Absolute specifications for the most appropriate operating temperature range will be adequate. However performance at other temperatures may be determined by including an allowance for temperature coefficient over the additional temperature range. Care should be taken when making this calculation, as an amount of temperature coefficient is already included in the 8508A specifications, and those specifications are themselves based on combining contributions using techniques similar to those employed in uncertainty analysis. For example, consider operating at $33\text{ }^{\circ}\text{C}$, $10\text{ }^{\circ}\text{C}$ from the $23\text{ }^{\circ}\text{C}$ calibration temperature. The $\pm 5\text{ }^{\circ}\text{C}$ specifications already include a contribution for $5\text{ }^{\circ}\text{C}$ of temperature difference, so this amount of temperature effect must be removed before the effect of the $10\text{ }^{\circ}\text{C}$ difference is added. Consider 10 V on the 20 VDC range: 365 day absolute specification (95 %) at $33\text{ }^{\circ}\text{C}$ expressed in parts-per-million of 10 V is:

$$\pm \sqrt{(3.5 + 0.2 \times \frac{20}{10})^2 - (5 \times 0.3)^2 + (10 \times 0.5)^2}$$

$$= \pm 6.16 \text{ ppm of } 10 \text{ V}$$



The Fluke 8508A and 8508A-SPRT Standard Platinum Resistance Thermometer



Applying the specifications

Ratio measurements

The 8508A Ratio mode will automatically take measurements of inputs applied to the front and rear terminals and display the result as a ratio in the voltage and resistance functions. The measurements can be made on the same range or different ranges. When making measurements on different ranges, the error in each measurement is evaluated by applying the relevant specification for each range and combining the two specifications in an RSS summation, expressing the contributions in parts-per-million of the measured values. For example, making measurements of the ratio of 100 mV on the 200 mVDC range and 100 V on the 200 VDC range, applying the 365 day ± 1 °C Absolute specifications:

$$\pm \sqrt{\left(4.5 + 0.5 \times \frac{200 \times 10^{-3}}{100 \times 10^{-3}}\right)^2 + \left(4.5 + 0.2 \times \frac{200}{100}\right)^2}$$
$$= \pm 7.37 \text{ ppm of the ratio}$$

Making measurements on the same range will eliminate range-to-range errors, such as drift since the time of calibration, and improve the result. When making measurements on the same range, these errors will affect both measurements and effectively cancel, leaving short term noise and linearity as the dominant errors. The 20 minute Transfer Uncertainty specifications are provided to describe the performance obtained when making ratio measurements on the same range. The error in each measurement is evaluated by applying the relevant 20 minute Transfer Uncertainty Specification for each value and combining the two specifications in an RSS summation, expressing the contributions in parts-per-million of the measured values. If the measurements are made within the same range, but independently (not using the ratio mode) with an elapsed time greater than 20 minutes but less than 24 hours between the measurements, then the 24 hour specifications should be applied instead.

For example, making measurements of the ratio of 5 V and 10 V on the 20 VDC range, applying the 20 minute Transfer Uncertainty Specifications:

$$\pm \sqrt{\left(0.12 + 0.1 \times \frac{20}{5}\right)^2 + \left(0.12 + 0.1 \times \frac{20}{10}\right)^2}$$
$$= \pm 0.61 \text{ ppm of the ratio}$$

Additional errors

The 8508A specifications are listed for the maximum resolution in each function, using the Normal reading mode. For measurements taken in other resolutions or the Fast read mode additional error contributions listed in the Read Rate and Additional Uncertainty table must be included. These additional contributions must be added algebraically to the relevant specifications. For example, measuring 10 V on the 20 VDC range at 5 digit resolution in Fast mode and applying the 365 day ± 1 °C Absolute specifications:

$$\pm \left((3.0 + 0) + (0.2 + 25) \times \frac{20}{10} \right)$$
$$= \pm (3.0 + 50.4) = \pm 53.4 \text{ ppm of 10 V}$$

Other additional contributions apply in certain situations and are also to be added algebraically to the relevant specifications. These additional contributions include the DC Accuracy specification to be applied when making DC measurements on the AC Voltage function when DC coupled, and the High Voltage Adder when making measurements above 300 V on the AC function.

DC Voltage specifications

DC Voltage ^{[1] [2] [3]}						
Range	Full Scale	Uncertainty Relative to Cal Stds			Absolute Uncertainties	
		± (ppm Reading + ppm Range) ^[4]				
		24 hour TCal ±1 °C	90 day TCal ±1 °C	365 day TCal ±1 °C	365 day TCal ±1 °C	365 day TCal ±5 °C
95 % Confidence Level						
200 mV	199.999 999	0.7 + 0.5	1.4 + 0.5	2.7 + 0.5	4.5 + 0.5	5.0 + 0.5
2 V	1.999 999 99	0.5 + 0.2	1.4 + 0.2	2.7 + 0.2	3.0 + 0.2	3.5 + 0.2
20 V	19.999 999 9	0.5 + 0.2	1.4 + 0.2	2.7 + 0.2	3.0 + 0.2	3.5 + 0.2
200 V	199.999 999	1.0 + 0.2	2.6 + 0.2	4.0 + 0.2	4.5 + 0.2	5.5 + 0.2
1000 V	1050.000 00	1.0 + 0.5	2.6 + 0.5	4.0 + 0.5	4.5 + 0.5	5.5 + 0.5
99 % Confidence Level						
200 mV	199.999 999	0.8 + 0.6	2.0 + 0.6	3.5 + 0.6	6.0 + 0.6	6.5 + 0.6
2 V	1.999 999 99	0.6 + 0.25	1.8 + 0.25	3.5 + 0.25	4.0 + 0.25	4.5 + 0.25
20 V	19.999 999 9	0.6 + 0.25	1.8 + 0.25	3.5 + 0.25	4.0 + 0.25	4.5 + 0.25
200 V	199.999 999	1.2 + 0.25	3.5 + 0.25	5.2 + 0.25	6.0 + 0.25	7.0 + 0.25
1000 V	1050.000 00	1.2 + 0.6	3.5 + 0.6	5.2 + 0.6	6.0 + 0.6	7.0 + 0.6

DC Voltage (Secondary Specifications) ^{[1] [2] [3]}			
Range	Transfer Uncertainty 20 mins ±1 °C ± (ppm Reading + ppm Range)	Temperature Coefficient	
		15 °C - 30 °C	5 °C - 15 °C 30 °C - 40 °C
		± ppm Reading/°C	
200 mV	0.4 + 0.3	0.4	0.6
2 V	0.12 + 0.1	0.3	0.5
20 V	0.12 + 0.1	0.3	0.5
200 V	0.4 + 0.1	0.7	1.0
1000 V	0.4 + 0.3	0.7	1.0

Type

CMRR (1 kΩ unbalance) ^[5]

NMRR ^[5]

Filter Out

Filter In

Protection (All ranges)

Input Impedance

200 mV to 20 V Ranges

200 V & 1000 V Ranges

Max Input Current

Ratio Accuracy

Range to Range

Within Range

Settling Time (to 10 ppm step size)

Filter Out

Filter In

Multi-slope, multi-cycle A-D Converter

140 dB at DC and 1 - 60 Hz

60 dB at 50/60 Hz ±0.09 %

110 dB at 50/60 Hz ±0.09 %

1 kV rms

>100 GΩ

10.1 MΩ ± 1 %

50 pA

±(Net Front Input Accuracy + Net Rear Input Accuracy)

Apply 24 hour or 20 minute Transfer

Uncertainty specifications

<50 ms

<1 s

DC Current specifications

DC Current ^{[1] [2] [3]}						
Range	Full Scale	Uncertainty Relative to Cal Stds			Absolute Uncertainties	
		± (ppm Reading + ppm Range) ^[4]				
		24 hour TCal ±1 °C	90 day TCal ±1 °C	365 day TCal ±1 °C	365 day TCal ±1 °C	365 day TCal ±5 °C
95 % Confidence Level						
200 µA	199.999 99	5.5 + 2.0	6.0 + 2.0	6.5 + 2.0	12 + 2.0	12 + 2.0
2 mA	1.999 999 9	5.5 + 2.0	6.0 + 2.0	6.5 + 2.0	12 + 2.0	12 + 2.0
20 mA	19.999 999	6.5 + 2.0	7.0 + 2.0	8.0 + 2.0	13 + 2.0	14 + 2.0
200 mA	199.999 99	28 + 4.0	30 + 4.0	33 + 4.0	36 + 4.0	48 + 4.0
2 A	1.999 999 9	80 + 8.0	125 + 8.0	170 + 8.0	170 + 8.0	185 + 8.0
20 A	19.999 999	200 + 20	290 + 20	380 + 20	380 + 20	400 + 20
99 % Confidence Level						
200 µA	199.999 99	7.0 + 2.0	7.5 + 2.0	8.0 + 2.0	15 + 2.0	16 + 2.0
2 mA	1.999 999 9	7.0 + 2.0	7.5 + 2.0	8.0 + 2.0	15 + 2.0	16 + 2.0
20 mA	19.999 999	8.0 + 2.0	9.0 + 2.0	10 + 2.0	16 + 2.0	18 + 2.0
200 mA	199.999 99	35 + 4.0	37 + 4.0	40 + 4.0	45 + 4.0	60 + 4.0
2 A	1.999 999 9	100 + 8.0	150 + 8.0	205 + 8.0	210 + 8.0	225 + 8.0
20 A	19.999 999	250 + 20	350 + 20	450 + 20	455 + 20	500 + 20

DC Current (Secondary Specifications) ^{[1] [2] [3]}				
Range	Input Impedance (W)		Temperature Coefficient	
			15 °C - 30 °C	5 °C - 15 °C 30 °C - 40 °C
	Front	Rear	± ppm Reading/°C	
200 µA	150	150	0.4	0.6
2 mA	15.2	15.2	0.4	0.6
20 mA	1.8	1.9	1.2	1.8
200 mA	1.2	1.3	6.0	9.0
2 A	0.3	0.4	8.0	12
20 A	0.04	-	8.0	12

Type

Multi-slope, multi-cycle A-D Converter

Protection

Front Input

20 A rms

Rear Input

2 A rms, Rear Panel Fuse

Settling Time

200 µA to 200 mA Ranges, to 10 ppm step size

Filter Out <50 ms, Filter In <1 s

2 A Range to 10 ppm step size

<1 s

20 A Range to 100 ppm step size

<30 s

AC Voltage specifications

AC Voltage ^[1] ^[2] ^[6] ^[7]							
Range	Full Scale	Frequency (Hz)	Uncertainty Relative to Cal Stds			Absolute Uncertainties	
			± (ppm Reading + ppm Range) ^[4]				
			24 hour TCal ±1 °C	90 day TCal ±1 °C	365 day TCal ±1 °C	365 day TCal ±1 °C	365 day TCal ±5 °C
95 % Confidence Level							
200 mV	199.999 9	1 - 10	80 + 70	120 + 70	120 + 70		
		10 - 40	80 + 20	120 + 20	120 + 20	130 + 20	140 + 20
		40 - 100	60 + 20	100 + 20	100 + 20	110 + 20	115 + 20
		100 - 2k	40 + 10	100 + 10	100 + 10	105 + 10	110 + 10
		2k - 10k	60 + 20	100 + 20	100 + 20	105 + 20	135 + 20
		10k - 30k	250 + 30	300 + 40	300 + 40	305 + 40	340 + 40
		30k - 100k	400 + 100	700 + 100	700 + 100	705 + 100	765 + 100
2 V, 20 V & 200 V	1.999 999 19.999 99 199.999 9	1 - 10	70 + 60	100 + 60	100 + 60		
		10 - 40	70 + 10	100 + 10	100 + 10	105 + 10	115 + 10
		40 - 100	50 + 10	80 + 10	80 + 10	85 + 10	90 + 10
		100 - 2k	30 + 10	60 + 10	60 + 10	65 + 10	75 + 10
		2k - 10k	50 + 10	80 + 10	80 + 10	85 + 10	110 + 10
		10k - 30k	100 + 20	200 + 20	200 + 20	205 + 20	220 + 20
		30k - 100k	250 + 100	500 + 100	500 + 100	505 + 100	570 + 100
100k - 300k	0.15% + 0.1%	0.3% + 0.1%	0.3% + 0.1%	0.3% + 0.1%	0.3% + 0.1%	0.3% + 0.1%	
300k - 1M	1% + 0.5%	1% + 1%	1% + 1%	1% + 1%	1% + 1%	1% + 1%	
1000 V ^[8]	1050.000	1 - 10	70 + 70	100 + 70	100 + 70		
		10 - 40	70 + 20	100 + 20	100 + 20	110 + 20	120 + 20
		40 - 10k	50 + 20	80 + 20	80 + 20	95 + 20	115 + 20
		10k - 30k	100 + 40	200 + 40	200 + 40	205 + 40	225 + 40
		30k - 100k	250 + 200	500 + 200	500 + 200	510 + 200	580 + 200
99 % Confidence Level							
200 mV	199.999 9	1 - 10	90 + 80	140 + 80	140 + 80		
		10 - 40	90 + 25	140 + 25	140 + 25	145 + 25	160 + 25
		40 - 100	70 + 25	115 + 25	115 + 25	125 + 25	135 + 25
		100 - 2k	45 + 12	115 + 12	115 + 12	125 + 12	135 + 12
		2k - 10k	70 + 25	115 + 25	115 + 25	125 + 25	165 + 25
		10k - 30k	270 + 35	340 + 50	340 + 50	345 + 50	395 + 50
		30k - 100k	450 + 120	750 + 120	750 + 120	755 + 120	855 + 120
2 V, 20 V & 200 V	1.999 999 19.999 99 199.999 9	1 - 10	80 + 70	115 + 70	115 + 70		
		10 - 40	80 + 12	115 + 12	115 + 12	120 + 12	135 + 12
		40 - 100	60 + 12	90 + 12	90 + 12	95 + 12	110 + 12
		100 - 2k	35 + 12	70 + 12	70 + 12	75 + 12	90 + 12
		2k - 10k	60 + 12	90 + 12	90 + 12	95 + 12	135 + 12
		10k - 30k	115 + 25	240 + 25	240 + 25	245 + 25	260 + 25
		30k - 100k	270 + 120	550 + 120	550 + 120	555 + 120	650 + 120
100k - 300k	0.15% + 0.12%	0.3% + 0.12%	0.3% + 0.12%	0.3% + 0.12%	0.3% + 0.12%	0.3% + 0.12%	
300k - 1M	1% + 0.6%	1% + 1.2%	1% + 1.2%	1% + 1.2%	1% + 1.2%	1% + 1.2%	
1000 V ^[8]	1050.000	1 - 10	80 + 80	115 + 80	115 + 80		
		10 - 40	80 + 25	115 + 25	115 + 25	135 + 25	145 + 25
		40 - 10k	60 + 25	90 + 25	90 + 25	110 + 25	140 + 25
		10k - 30k	115 + 50	240 + 50	240 + 50	250 + 50	265 + 50
		30k - 100k	270 + 250	600 + 250	600 + 250	615 + 250	700 + 250

AC Voltage specifications (cont.)

AC Voltage (Secondary Specifications) ^{[1] [2]}			
Range	Frequency (Hz)	Temperature Coefficient	
		15 °C - 30 °C	5 °C - 15 °C
		30 °C - 40 °C	
± ppm Reading/°C			
200 mV	1 - 10	5	10
	10 - 40	5	10
	40 - 100	5	10
	100 - 2k	5	10
	2k - 10k	12	20
	10k - 30k	15	20
	30k - 100k	40	60
2 V 20 V 200 V	1 - 10	5	10
	10 - 40	5	10
	40 - 100	5	10
	100 - 2k	5	10
	2k - 10k	10	15
	10k - 30k	12	20
	30k - 100k	40	60
	100k - 300k	60	90
	300k - 1M	80	120
1000 V	1 - 10	5	10
	10 - 40	5	10
	40 - 10k	10	15
	10k - 30k	12	20
	30k - 100k	40	60

Type

True RMS, AC coupled measures AC component with up to 1000 V DC bias on any range. DC coupled gives $\sqrt{ac^2 + dc^2}$
>90 dB DC - 60 Hz

CMRR (1 kΩ unbalance) ^[5]

Crest Factor

200 mV to 200 V ranges
1000 V range

10:1 at 12 % of range, 5:1 at 50 % of range, 2.5:1 at full range
10:1 at 25 % of range, 5:1 at full range

Protection (All ranges)

1 kV rms

Input Impedance

1 MΩ in parallel with 150 pF

DC Accuracy (DC Coupled) ^[13]

Add ±(50 ppm Reading + 50 ppm Range + 20 μV)

Ratio Accuracy

Range to Range
Within Range

±(Net Front Input Accuracy + Net Rear Input Accuracy)

Apply 24 hour or 20 minute Transfer Uncertainty specifications

Settling Time (to 100 ppm step size)

100 Hz
40 Hz
10 Hz
1 Hz

<0.5 s
<1.25 s
<5 s
<50 s

Frequency Measurement

Signal Amplitude Range

5 % of range to limit set by maximum V.Hz

Gate Mode

Normal

Fast

Resolution

6.5 digits

4.5 digits

Frequency Range

10 Hz - 1 MHz

200 Hz - 1 MHz

Accuracy (1 year, 13 °C - 33 °C)

± (10 ppm of Reading + 2 digits)

± 2 digits

Sample Interval

1 s

50 ms

AC Current specifications

AC Current ^{[1] [2] [6] [9]}							
Range	Full Scale	Frequency (Hz)	Uncertainty Relative to Cal Stds			Absolute Uncertainties	
			± (ppm Reading + ppm Range) ^[4]				
			24 hour TCal ±1 °C	90 day TCal ±1 °C	365 day TCal ±1 °C	365 day TCal ±1 °C	365 day TCal ±5 °C
95 % Confidence Level							
200 µA, 2 mA & 20 mA	199.999 9 1.999 999 19.999 99	1 - 10	200 + 100	250 + 100	250 + 100		
		10 - 10k	200 + 100	250 + 100	250 + 100	280 + 100	300 + 100
		10k - 30k	500 + 100	600 + 100	600 + 100	650 + 100	710 + 100
		30k - 100k	0.35 % + 100	0.4 % + 100	0.4 % + 100	0.4 % + 100	0.4 % + 100
200 mA	199.999 9	1 - 10	200 + 100	250 + 100	250 + 100		
		10 - 10k	200 + 100	250 + 100	250 + 100	250 + 100	290 + 100
		10k - 30k	500 + 100	600 + 100	600 + 100	600 + 100	625 + 100
2 A	1.999 999	10 - 2k	500 + 100	600 + 100	600 + 100	600 + 100	620 + 100
		2k - 10k	600 + 100	700 + 100	700 + 100	700 + 100	725 + 100
		10k - 30k	0.25 % + 100	0.3 % + 100	0.3 % + 100	0.3 % + 100	0.3 % + 100
20 A	19.999 99	10 - 2k	700 + 100	800 + 100	800 + 100	800 + 100	820 + 100
		2k - 10k	0.2 % + 100	0.25 % + 100	0.25 % + 100	0.25 % + 100	0.25 % + 100
99 % Confidence Level							
200 µA, 2 mA & 20 mA	199.999 9 1.999 999 19.999 99	1 - 10	250 + 120	300 + 120	300 + 120		
		10 - 10k	250 + 120	300 + 120	300 + 120	340 + 120	370 + 120
		10k - 30k	600 + 120	700 + 120	700 + 120	775 + 120	800 + 120
		30k - 100k	0.35 % + 120	0.4 % + 120	0.4 % + 120	0.4 % + 120	0.4 % + 120
200 mA	199.999 9	1 - 10	250 + 120	300 + 120	300 + 120		
		10 - 10k	250 + 120	300 + 120	300 + 120	305 + 120	360 + 120
		10k - 30k	600 + 120	700 + 120	700 + 120	700 + 120	740 + 120
2 A	1.999 999	10 - 2k	600 + 120	700 + 120	700 + 120	705 + 120	725 + 120
		2k - 10k	700 + 120	800 + 120	800 + 120	815 + 120	860 + 120
		10k - 30k	0.25 % + 120	0.3 % + 120	0.3 % + 120	0.3 % + 120	0.3 % + 120
20 A	19.999 99	10 - 2k	800 + 120	900 + 120	900 + 120	900 + 120	920 + 120
		2k - 10k	0.2 % + 120	0.25 % + 120	0.25 % + 120	0.25 % + 120	0.25 % + 120

AC Current specifications (cont.)

AC Current (Secondary Specifications) ^{[1] [2] [6] [9]}						
Range	Frequency (Hz)	Temperature Coefficient		Input Impedance (W)		
		15 °C - 30 °C	5 °C - 15 °C 30 °C - 40 °C	Range	Front	Rear
		± ppm Reading/°C				
200 µA, 2 mA & 20 mA	1 - 10	10	15	200 µA	150	150
	10 - 10k	10	15	2 mA	15.2	15.2
	10k - 30k	12	20	20 mA	1.8	1.9
	30k - 100k	40	60			
200 mA	1 - 10	10	15		1.2	1.3
	10 - 10k	15	20			
	10k - 30k	15	20			
2 A	10 - 2k	10	15		0.3	0.4
	2k - 10k	15	20			
	10k - 30k	20	30			
20 A	10 - 2k	10	15		0.04	-
	2k - 10k	15	20			

Type

True RMS, AC coupled. DC coupled gives $\sqrt{ac^2 + dc^2}$

Crest Factor

3:1 at 50 % of range, 1.5:1 at full range

Protection

Front Input

20 A rms

Rear Input

2 A rms, Rear Panel Fuse

Settling Time (to 100 ppm step size)

200 µA to 2 A Ranges

20 A Range

100 Hz

<0.5 s

<30 s

40 Hz

<1.25 s

<30 s

10 Hz

<5 s

<30 s

1 Hz

<50 s

<50 s

Resistance specifications

Resistance ^[1] ^[2] ^[3] ^[9]							
Range	Full Scale	Mode ^[10]	Uncertainty Relative to Cal Stds			Absolute Uncertainties	
			± (ppm Reading + ppm Range) ^[4]				
			24 hour TCal ±1 °C	90 day TCal ±1 °C	365 day TCal ±1 °C	365 day TCal ±1 °C	365 day TCal ±5 °C
95 % Confidence Level							
2 Ω	1.999 999 99	Normal	5.0 + 2.0	8.0 + 2.0	10 + 2.0	15 + 2.0	17 + 2.0
20 Ω	19.999 999 9	Normal	2.5 + 0.7	4.5 + 0.7	7.0 + 0.7	9.0 + 0.7	9.5 + 0.7
200 Ω	199.999 999	Normal	1.5 + 0.25	4.0 + 0.25	7.0 + 0.25	7.5 + 0.25	8.0 + 0.25
2 kΩ	1.999 999 99	Normal	1.0 + 0.25	3.5 + 0.25	7.0 + 0.25	7.5 + 0.25	8.0 + 0.25
20 kΩ	19.999 999 9	Normal	1.0 + 0.25	3.5 + 0.25	7.0 + 0.25	7.5 + 0.25	8.0 + 0.25
200 kΩ	199.999 999	Normal	1.0 + 0.25	3.5 + 0.25	7.0 + 0.25	7.5 + 0.25	8.0 + 0.25
2 MΩ	1.999 999 99	Normal	2.0 + 0.5	4.0 + 0.5	7.0 + 0.5	8.5 + 0.5	9.0 + 0.5
20 MΩ	19.999 999 9	Normal	3.5 + 5.0	6.0 + 5.0	9.0 + 5.0	15 + 5.0	20 + 5.0
200 MΩ	199.999 999	Normal	20 + 50	25 + 50	30 + 50	60 + 50	120 + 50
2 GΩ	1.999 999 99	Normal	250 + 500	350 + 500	500 + 500	525 + 500	1510 + 500
2 Ω	1.999 999 99	Lo Current	5.0 + 2.0	8.0 + 2.0	10 + 2.0	15 + 2.0	17 + 2.0
20 Ω	19.999 999 9	Lo Current	2.5 + 0.7	4.5 + 0.7	7.0 + 0.7	9.0 + 0.7	9.5 + 0.7
200 Ω	199.999 999	Lo Current	2.5 + 0.7	5.0 + 0.7	7.0 + 0.7	7.5 + 0.7	8.0 + 0.7
2 kΩ	1.999 999 99	Lo Current	2.5 + 0.7	5.0 + 0.7	7.0 + 0.7	7.5 + 0.7	8.0 + 0.7
20 kΩ	19.999 999 9	Lo Current	2.5 + 0.7	5.0 + 0.7	7.0 + 0.7	7.5 + 0.7	8.0 + 0.7
200 kΩ	199.999 999	Lo Current	5.0 + 0.5	6.5 + 0.5	7.0 + 0.5	7.5 + 0.5	8.0 + 0.5
2 MΩ	1.999 999 99	Lo Current	7.0 + 0.5	8.0 + 0.5	9.0 + 0.5	10 + 0.5	15 + 0.5
20 MΩ	19.999 999 9	Lo Current	20 + 5.0	20 + 5.0	25 + 5.0	35 + 5.0	90 + 5.0
200 MΩ	199.999 999	Lo Current	250 + 500	350 + 500	500 + 500	515 + 500	1505 + 500
2 GΩ	1.999 999 99	Lo Current	250 + 500	350 + 500	500 + 500	525 + 500	1510 + 500
20 MΩ	19.999 999 9	High Voltage	2.0 + 0.5	4.0 + 0.5	7.0 + 0.5	15 + 0.5	17 + 0.5
200 MΩ	199.999 999	High Voltage	3.5 + 5.0	6.0 + 5.0	9.0 + 5.0	60 + 5.0	65 + 5.0
2 GΩ	1.999 999 99	High Voltage	20 + 50	25 + 50	30 + 50	150 + 50	180 + 50
20 GΩ	19.999 999 9	High Voltage	250 + 500	350 + 500	500 + 500	525 + 500	1510 + 500
99 % Confidence Level							
2 Ω	1.999 999 99	Normal	6.0 + 2.5	10 + 2.5	12 + 2.5	19 + 2.5	22 + 2.5
20 Ω	19.999 999 9	Normal	3.0 + 0.9	5.5 + 0.9	8.5 + 0.9	11.5 + 0.9	12.0 + 0.9
200 Ω	199.999 999	Normal	1.8 + 0.3	5.0 + 0.3	8.5 + 0.3	9.5 + 0.3	10 + 0.3
2 kΩ	1.999 999 99	Normal	1.2 + 0.3	4.5 + 0.3	8.5 + 0.3	9.5 + 0.3	10 + 0.3
20 kΩ	19.999 999 9	Normal	1.2 + 0.3	4.5 + 0.3	8.5 + 0.3	9.5 + 0.3	10 + 0.3
200 kΩ	199.999 999	Normal	1.2 + 0.3	4.5 + 0.3	8.5 + 0.3	9.5 + 0.3	10 + 0.3
2 MΩ	1.999 999 99	Normal	2.5 + 0.6	5.0 + 0.6	8.5 + 0.6	10.5 + 0.6	12 + 0.6
20 MΩ	19.999 999 9	Normal	4.5 + 6.0	7.5 + 6.0	12 + 6.0	20 + 6.0	25 + 6.0
200 MΩ	199.999 999	Normal	25 + 60	30 + 60	35 + 60	75 + 60	150 + 60
2 GΩ	1.999 999 99	Normal	325 + 600	450 + 600	650 + 600	675 + 600	1810 + 500
2 Ω	1.999 999 99	Lo Current	6.0 + 2.5	10 + 2.5	12 + 2.5	19 + 2.5	22 + 2.5
20 Ω	19.999 999 9	Lo Current	3.0 + 0.9	5.5 + 0.9	8.5 + 0.9	11.5 + 0.9	12.0 + 0.9
200 Ω	199.999 999	Lo Current	3.0 + 0.9	6.5 + 0.9	8.5 + 0.9	9.5 + 0.9	10.0 + 0.9
2 kΩ	1.999 999 99	Lo Current	3.0 + 0.9	6.5 + 0.9	8.5 + 0.9	9.5 + 0.9	10.0 + 0.9
20 kΩ	19.999 999 9	Lo Current	3.0 + 0.9	6.5 + 0.9	8.5 + 0.9	9.5 + 0.9	10.0 + 0.9
200 kΩ	199.999 999	Lo Current	6.0 + 0.6	8.0 + 0.6	9.0 + 0.6	9.5 + 0.6	10.0 + 0.6
2 MΩ	1.999 999 99	Lo Current	8.0 + 0.6	10.0 + 0.6	12.0 + 0.6	13.0 + 0.6	17.0 + 0.6
20 MΩ	19.999 999 9	Lo Current	25 + 6.0	25 + 6.0	30 + 6.0	45 + 6.0	110 + 6.0
200 MΩ	199.999 999	Lo Current	325 + 600	450 + 600	650 + 600	670 + 600	1810 + 600
2 GΩ	1.999 999 99	Lo Current	325 + 600	450 + 600	650 + 600	675 + 600	1810 + 600
20 MΩ	19.999 999 9	High Voltage	2.5 + 0.6	5.0 + 0.6	8.5 + 0.6	19 + 0.6	20 + 0.6
200 MΩ	199.999 999	High Voltage	4.5 + 6.0	7.5 + 6.0	12 + 6.0	75 + 6.0	80 + 6.0
2 GΩ	1.999 999 99	High Voltage	25 + 60	30 + 60	35 + 60	195 + 60	230 + 60
20 GΩ	19.999 999 9	High Voltage	325 + 600	450 + 600	650 + 600	675 + 600	1810 + 600

Resistance specifications (cont.)

Resistance - Normal Mode (Secondary Specifications) ^{[1] [2] [3] [10]}				
Range	Measurement Current	Transfer Uncertainty 20 mins ± 1 °C \pm (ppm Reading + ppm Range)	Temperature Coefficient	
			15 °C - 30 °C	5 °C - 15 °C 30 °C - 40 °C
			\pm ppm Reading/°C	
2 Ω	100 mA	2.0 + 2.0	1.5	2.5
20 Ω	10 mA	0.8 + 0.7	0.6	1.0
200 Ω	10 mA	0.2 + 0.15	0.5	0.8
2 k Ω	1 mA	0.2 + 0.15	0.5	0.8
20 k Ω	100 μ A	0.2 + 0.15	0.5	0.8
200 k Ω	100 μ A	0.2 + 0.15	0.5	0.8
2 M Ω	10 μ A	0.5 + 0.5	0.6	1.0
20 M Ω	1 μ A	2.5 + 5	2	3
200 M Ω	100 nA	15 + 50	20	30
2 G Ω	10 nA	200 + 500	200	300

Resistance - Lo Current Mode (Secondary Specifications) ^{[1] [2] [3] [10]}				
Range	Measurement Current	Transfer Uncertainty 20 mins ± 1 °C \pm (ppm Reading + ppm Range)	Temperature Coefficient	
			15 °C - 30 °C	5 °C - 15 °C 30 °C - 40 °C
			\pm ppm Reading/°C	
2 Ω	100 mA	2.0 + 2.0	1.5	2.5
20 Ω	10 mA	0.8 + 0.7	0.6	1.0
200 Ω	1 mA	0.8 + 0.7	0.6	1.0
2 k Ω	100 μ A	0.8 + 0.7	0.6	1.0
20 k Ω	10 μ A	0.8 + 0.7	0.6	1.0
200 k Ω	10 μ A	0.5 + 0.5	0.6	1.0
2 M Ω	100 nA	2.0 + 0.5	2	3
20 M Ω	100 nA	15 + 5	20	30
200 M Ω	10 nA	200 + 500	200	300
2 G Ω	10 nA	200 + 500	200	300

Resistance - High Voltage Mode (Secondary Specifications) ^{[1] [2] [3]}				
Range ^[9]	Measurement Current	Transfer Uncertainty 20 mins ± 1 °C \pm (ppm Reading + ppm Range)	Temperature Coefficient	
			15 °C - 30 °C	5 °C - 15 °C 30 °C - 40 °C
			\pm ppm Reading/°C	
20 M Ω	10 μ A	0.5 + 0.5	0.6	1.0
200 M Ω	1 μ A	2.0 + 0.5	2.0	3
2 G Ω	100 nA	15 + 50	20	30
20 G Ω	10 nA	200 + 500	200	300

Type

True 4-wire with Ohms guard. 2-wire selectable.

Max Lead Resistance

10 Ω in any or all leads, 1 Ω on 2 Ω range

Full Scale Measurement Voltage

Normal Mode

200 mV/2 V/20 V

Lo Current Mode

200 mV/2 V

High Voltage Mode

200 V

Protection (All ranges)

250 V rms, 360 V pk

Ratio Accuracy

Range to Range

\pm (Net Front Input Accuracy + Net Rear Input Accuracy)

Within Range

Apply 24 hour or 20 minute Transfer Uncertainty specifications

Settling Time

Up to 200 k Ω range generally the same as DC Voltage Filter In but depends on external connections

Temperature specifications

Temperature Readout ^{[1] [2] [3]}					
Resistance Range	Absolute Resistance Measurement Uncertainty 365 day TCal $\pm 1\text{ }^\circ\text{C}$ ^[4] $\pm(\text{ppm Reading} + \text{mW})$ ^[11]	Typical Equivalent Temperature Measurement Uncertainty ^[12]			
		Probe Type	Nominal Temp ($^\circ\text{C}$)	Resistance (W)	Accuracy \pm ($^\circ\text{C}$)
95 % Confidence Level					
0 - 199.999 999 W	7.5 + 0.14	25 Ω PRT/SPRT	-200	5	0.0085
		25 Ω PRT/SPRT	0	25	0.0035
		25 Ω PRT/SPRT	660	84	0.0025
		100 Ω PRT/SPRT	-200	20	0.0035
		100 Ω PRT/SPRT	0	100	0.0025
		100 Ω PRT/SPRT	232	185	0.0020
200 - 1999.999 99 W	7.5 + 0.5	100 Ω PRT/SPRT	400	250	0.0025
99 % Confidence Level					
0 - 199.999 999 W	9.5 + 0.18	25 Ω PRT/SPRT	-200	5	0.0100
		25 Ω PRT/SPRT	0	25	0.0040
		25 Ω PRT/SPRT	660	84	0.0025
		100 Ω PRT/SPRT	-200	20	0.0040
		100 Ω PRT/SPRT	0	100	0.0025
		100 Ω PRT/SPRT	232	185	0.0020
200 - 1999.999 99 W	9.5 + 0.6	100 Ω PRT/SPRT	400	250	0.0025

Temperature Readout (Secondary Specifications) ^{[1] [2] [3]}					
Resistance Range	Resistance Measurement Uncertainty				
	Transfer Uncertainty 20 Minute $\pm 1\text{ }^\circ\text{C}$ $\pm(\text{ppm Reading} + \text{mW})$ ^[11]	2-Wire Adder (W)	3-Wire Adder (W)	Temp Coeff. \pm ppm Reading/$^\circ\text{C}$	
				15 $^\circ\text{C}$ - 30 $^\circ\text{C}$	5 $^\circ\text{C}$ - 15 $^\circ\text{C}$ 30 $^\circ\text{C}$ - 40 $^\circ\text{C}$
0 - 199.999 999 W	0.8 + 0.14	0.1	0.005	0.6	1.0
200 - 1999.999 99 W	0.2 + 0.5	0.1	0.005	0.5	0.8

- Type** 4-wire current reversal resistance measurement with readout of equivalent temperature. 2-wire and 3-wire selectable without current reversal. Refer to Resistance specifications for additional details.
- Temperature Range** -200 $^\circ\text{C}$ to 660 $^\circ\text{C}$, readout also available in $^\circ\text{F}$ or K.
- Linearization** ITS-90 or Callendar van Dusen. Entry and storage of coefficients and nominal resistance for up to 100 probes.
- Current Source** 1 mA

Read Rate and additional Uncertainty

Read Rate and Additional Uncertainty Specifications						
Function	Resolution	Filter Frequency (Hz)	Read Rate (readings/second)		Additional Errors ^[13] ±(ppm Reading + ppm Range)	
			Normal	Fast	Normal	Fast
DCV, DCI & Ohms ^[10]	8					
	7		1/25	1/6	0 + 0	0 + 0.1
	6		1/6	1/2	0 + 0.1	0 + 0.5
	5		2	35	0 + 0.5	0 + 2.5
			35	150	0 + 5	0 + 25
ACV & ACI ^[6]	6	1	1/50		0 + 0	
		10	1/5		0 + 0	
		40	1/2		0 + 0	
		100	1		0 + 0	
	5	1	1/50		0 + 5	
		10	1/5		0 + 5	
		40	1/2		0 + 5	
		100	2		0 + 5	
ACV Transfer Off ^[6]		1	1/25		200 + 20	
		10	1/2.5		200 + 20	
		40	1		200 + 20	
		100	4		200 + 20	
PRT & Tru Ohms ^[14]	8	-	1/90	1/30	0 + 0	
	7	-	1/30	1/10	0 + 0.1	
	6	-	1/4	1/3	0 + 0.5	
	5	-	1/3	1/3	0 + 5	

General specifications

General Specifications	
Power	
Voltage	100 V to 120 V ±10 % or 200 V to 240 V ±10 %
Frequency	47 Hz to 63 Hz
Consumption	80 VA
Dimensions	
Height	88 mm (3.5 inches)
Width	427 mm (16.8 inches)
Depth	487 mm (19.2 inches)
Weight	11.5 kg (25.5 lbs)
Environment	
Temperature:	
Operating	0 °C to 50 °C
Specified Operation	5 °C to 40 °C
Calibration (TCal)	20 °C to 25 °C
Factory Cal Temperature	23 °C
Storage	-20 °C to 70 °C
Warm Up	4 hours to full uncertainty specification
Relative Humidity:	(non condensing)
Operating	< 90 % (5 °C to 40 °C)
Storage	< 95 % (0 °C to 70 °C)
Altitude:	
Operating	< 2000 m
Storage	< 12000 m
Vibration and Shock:	Complies with MIL-PRF-28800F Class 3
EMC	EN50081-1 Class B, EN55011/22, EN61326-1:1998, EN50082-1, EN55011 1991 Class B, EN61000-6-1:2001, FCC Rules part 15 sub part J class B, CE marked.

General Specifications (cont.)	
Safety	Designed and tested to EN61010-1-2001, UL 61010-1A1, CAN/CSA 22.2 No. 61010.1, CE and ETL marked. Pollution Degree 2. Installation Category II. Equipment Class I (single insulation / Earthed metal case). Protection against water ingress IP4X (general indoor conditions). Input circuitry and connections (creepage and clearances) designed to interface at Installation or Measurement Category I.
Measurement Isolation	
Guard to Safety Ground	<3300 pF, >10 GΩ
Lo to Guard:	
In Remote Guard	<2800 pF, >10 GΩ (Not in Resistance function)
In Local Guard	Lo and Guard terminals are internally shorted (in Resistance <2800 pF, >10 GΩ)
Autorange	
Range Up	100 % of nominal range
Range Down	9 % of nominal range (18 % on 1 kV range)
Remote Interface	IEEE 488.2
Warranty	1 Year

Notes:

- [1] Specifications apply for max resolution in each function, normal mode
- [2] Assumes 4 hour warm-up period
- [3] Input zero or offset null required whenever the temperature moves more than ±1 °C from the temperature at which the previous null/zero was performed
- [4] TCal = Ambient calibration temperature
- [5] Integration time > 1 Power Line cycle
- [6] Valid for signals >1 % Full Scale, Transfer Mode On. Signal must be DC coupled <40 Hz. Readings invalid with Transfer Mode On and 1 Hz filter selected when using internal trigger mode
- [7] Max Volt.Hertz 3×10^7
- [8] >300 V, <10 kHz add: $\pm 0.0004 (R-300)^2$ ppm
 >300 V, 10 kHz - 30 kHz add: $\pm (0.0004 + (F - 10000) \times 1E-7) \times (R-300)^2$ ppm
 >300 V, >30 kHz add: $\pm 0.0024 (R-300)^2$ ppm
- [9] Typical above 10 kHz for ACI and above 2 GΩ for Resistance
- [10] Tru Ohms mode available on 2 Ω to 20 kΩ ranges. Read Rate reduced in Tru Ohms mode. Specification for Tru Ohms same as corresponding Normal or Lo Current range.
- [11] Valid for 4-wire sensor
- [12] Not including sensor uncertainty
- [13] Assume Range and Full Scale = 2000 V when calculating for 1000 V Range. For DCI, additional errors only apply in 5 digit resolution
- [14] Fast mode not available in PRT

Ordering information

Model

8508A	8.5 digit Reference Multimeter, Certificate of Calibration and User Manual
8508A/01	8.5 digit Reference Multimeter with front & rear input binding posts, Certificate of Calibration and User Manual

Accessories

NVLAP	NVLAP Accredited Calibration
UKAS	UKAS Accredited Calibration
8508A-SPRT	Standard Platinum Resistance Thermometer
8508A-PRT	100 Ω PRT
8508A-LEAD	Comprehensive Measurement Lead Kit
Y8508	Rack Mount Kit
Y8508S	Rack Mount Kit Slides
8508-7000K	Calibration Kit

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